On some Earthworms from the Cameron Highlands, Pahang

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A small collection of earthworms recently received from the Raffles Museum contains only specimens of new species or of species hitherto known only from the types. As the result of a study of this material several new species are added to the fauna of the Malay Peninsula, two older species are now more adequately characterized, and the genus *Drawida* is shown to be an important constituent of the earthworm fauna of the Peninsula.

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Genus **Drawida** Michælsen.

Drawida Michaelsen 1900, Das Tierreich, vol. 10, p. 114. (Genotype, *Moniligaster barwelli* Beddard 1886).

In a previous collection of earthworms from the Raffles Museum there was included a single individual of a species of *Drawida*. This genus had not hitherto been found in the Malay Peninsula. Unfortunately the worm just mentioned was aclitellate and it was not possible, therefore, to determine definitely the taxonomic characteristics of the species. The worm did, however, appear to be distinct from all species of *Drawida* known from the nearest Drawida areas (Burma and French Indo-China) and so a description of the specimen was included in the report on the collection.

In the present collection there are two further Drawida specimens, each of which, is, like the previous specimen, aclitellate. Unfortunately again, in view of the immaturity of these specimens and their condition, it is impossible to determine definitely the taxonomic characteristics of the species to which they belong. However, these worms can be distinguished specifically not only from each other but also from the earlier specimen. Descriptions of each of the new worms have accordingly been included hereinafter. The earlier specimen is designated as "A" and the two later specimens as "B" and "C".

The presence of three species of the genus *Drawida* in the Malay Peninsula brings this area definitely into a Drawida region which, as is now evident, comprises a large portion of southeastern Asia (India, Burma, China—in part at least, and French Indo-China) as well as Borneo, the Philippines and possibly also Japan and Sumatra.

Drawida sp. A.

The worm described in the previous paper (*vide* Bull. Raffles Museum number 10, p. 80) is distinguished specifically from the worm next described, "B", by the following characteristics:—location of the male pores (superficial) on protuberant porophores, absence of genital markings, length of the vas deferens, erect prostates, and the presence of erect spermathecal atria in vii.

Drawida sp. B.

Gunong Brinchang, Pahang. 3/35. 6,300 feet.
One aclitellate specimen.

External characteristics.—Length, 62 mm. Diameter, 4 mm. Pigmentation, light blueish on the dorsum. The prostomium is of the characteristic moniligastrid (prolobous) type.

The setæ begin, apparently, on iii, none were seen on ii. The setæ are closely paired, *ab*=*cd*, *bc* and *aa* about equal, *dd* slightly greater than one half the circumference. (Measurements made anterior to the softened region).

The nephridial pores on some of the anterior segments are displaced dorsal to *d*.

The spermathecal pores are minute and superficial, in 7/8, in or just median to *c*.

The external apertures of the male apparatus are fairly large, transverse slits in *bc*. The margins of the slits are tumescent and whitish.

The genital markings are, apparently, merely slight thickenings of the epidermis. There are two pairs of these markings on the middle annulus of x, in the transverse setal line; two markings in *bc* on each side. On *viii*, in *bc* near *c* and on the anterior annulus there is a transversely oval, slightly protuberant, whitish area.

Internal anatomy.—The gizzards are five, in xiii to xvii. The gut is narrow in xxiii, abruptly widened and darker coloured in xxiv. The last pair of hearts is in ix.

The testis sacs have an iridescent sheen and are fairly large, extending into both ix and x. The vas deferens is relatively very short. It passes downwards in ix, then through 9/10 and into x to the ventral parietes, proceeding straight posteriorly for a short distance and then into the parietes and at right angles to its former course passes laterally and fairly deeply within the muscular layer to the anterior margin of the prostate. The vas may be very slightly zigzagged but is practically without the usual looping. The prostate is represented by a patch of whitish material of longitudinally oval outline, on or in the parietes and is covered over by connective tissue. A glandular layer and central body could not be distinguished and in attempting to remove the dorsalmost layer of the prostate the transverse slit (male invagination) passing through the body wall was uncovered. The roof of the prostate over this slit is, apparently, thinner than elsewhere.

The ovarian chamber is horseshoe-shaped. The ovisacs are rudimentary, confined to xii. There are no free ova in the ovarian chamber or the ovisacs. The spermathecal ampullæ are small and collapsed. The duct is looped on the posterior face of 7/8 and close to the floor of viii passes through 7/8 and just in front of septum 7/8 is bent into a tiny, u-shaped loop, the concavity of the loop directed ventrally, the anterior limb passing straight down into the parietes. This loop, until examined closely, looks like a rounded, knob-like atrium on the floor of vii.

There is no glandular material visible in the cœlom in the vicinity of the genital markings.

Remarks.—The specimen is in poor condition. The region immediately behind the first intestinal segment is considerably macerated. The tissues of the anterior segments are also softened, the prostate in particular reduced to a sticky mass.

The slit-like apertures in 10/11 probably should not be termed male pores. The primary male pore which is doubtless minute is, presumably, invaginate.

The specimen just described is distinguished specifically from the earlier specimen, "A", by the invaginate male pores, the presence of genital markings, the shortness of the vas deferens, the passage of the vas deferens into the parietes prior to its entry into the prostates, the sessile prostates, and the absence of spermathecal atria. Some at least of these will eventually be shown to be valid specific characteristics.

Drawida sp. C.

Kuala Terla, Telom Valley, Pahang. 3/35. 4,000–4,500 feet. One aclitellate specimen.

External characteristics.—Length, 63 mm. Diameter, 3 mm. Unpigmented. The prostomium is of the characteristic moniligastrid type.

The setæ begin, apparently, on iii, none were seen on ii. The setæ are closely paired, $ab=cd$; on the segments just behind the male pores, $aa<bc$.

The spermathecal pores are minute and superficial, in 7/8, in *bc*, slightly nearer to *b* than to *c*, each pore on a tiny, transversely oval tumescence with pointed ends. The female pores are near the anterior margin of xii, just lateral to *b*.

The external apertures of the male apparatus are short, transverse slits in 10/11, in *bc*, much nearer to *b* than to *c*. There are no porophores but the margins of x and xi in the immediate vicinity of the pores are slightly tumescent.

There is a pair of fairly conspicuous genital markings on vii. Each marking is approximately circular, in *bc* just lateral to *b* with the lateral margin about in line with the spermathecal pore, extending across the middle and the posterior annuli of the segment. A circular area at the centre of each marking has more of a greyish translucent appearance than the peripheral portion.

Internal anatomy.—The gizzards are five, in xii to xvi, the one in xii much smaller than the others. The last pair of hearts is in ix.

The testis sacs are fairly large but only a small anterior portion of each sac projects through 9/10 into ix. The vas deferens is relatively short. It passes almost straight down the anterior face of 9/10 nearly to the floor of ix and then turns and runs up on or in 9/10 nearly to the base of the testis sac and then turns and passes ventrally again between the ental descending limb and the ascending limb. In x just posterior to 9/10 the vas is bent into several short loops and then passes into the anteromesial margin of the prostate, without first passing into the parietes. The prostate is represented by a patch of whitish material of circular outline, in or on the parieties. A glandular layer and a central body could not be distinguished and in attempting to remove the dorsal layer of the prostate the small transverse slit through the body wall was uncovered, the roof of the prostate just over this slit apparently rather thin.

The ovarian chamber is probably horseshoe-shaped. The ovisacs are rudimentary and confined to xii. There are no free ova in the ovarian chamber or the ovisacs. The spermathecal ampullæ are small, the ducts long and looped. There is no trace of an atrium in vii but the spermathecal duct is slightly thickened as it passes into the parieties just behind 7/8.

There is no glandular material visible in the cœlom in the region of the genital markings.

Remarks.—Like the preceding specimen this worm is in poor condition, macerated just behind the gizzard region, the tissues of the internal organs of the anterior segments softened, the prostate represented merely by a pasty mass.

The external apertures of the male apparatus are much smaller than in "B", and are here also probably not to be termed male pores. As in "B" it is likely that a minute male pore is invaginate.

The species to which this worm belongs can be readily distinguished from each of the two species to which specimens "A" and "B" belong by the more median location of the spermathecal pores. The species can also be distinguished from all Burmese Drawidas by this same characteristic.

Genus Pheretima Kinberg.

Pheretima Kinberg 1867, Ofv. Ak. Forh. vol. 23, p. 102. (Genotype, by subsequent designation—Michaelsen 1907—*P. montana* Kinberg 1867).

The Pahang species of *Pheretima* are remarkably uniform with regard to several characteristics. All are, so far as is known, provided with simple intestinal cæca. All, with the exception of *P. cameroni*, are small, some even quite small, as shown below.

Species	*Length*	*Diameter*
P. brinchangensis ..	60–85 mm.	3–6 mm.
eluta	37–65 mm.	2–3 mm.
miniata	55 mm.	4½ mm.
ralla	25–39 mm.	1½ mm.
rallida	66 mm.	3 mm.
rubella	30–60 mm.	2–3 mm.
rutila	40 mm.	2½ mm.
serena	38 mm.	2 mm.
sigillata	31 mm.	3 mm.

Furthermore, of the ten species described in this paper, six, *P. miniata, rallida, rubella, rutila, serena* and *sigillata* are characterized by the presence of septa 8/9 and 9/10 which are complete though membranous. Of the remaining species, two, *P. brinchangensis* and *eluta* are characterized by the presence of a complete though membranous septum 8/9.

Finally in all of the ten species described in this paper, excluding only *P. rubella* and *rutila*, the seminal vesicles of xi are included within the posterior testis sac or sacs.

In the genus *Pheretima*, septa 8/9 or 8/9 and 9/10 are usually lacking (or assumed to be lacking) or represented only by ventral rudiments. In *P. indica*, also a Peninsula form, septum 8/9 was originally overlooked and said to be absent. It is therefore possible that in still other Peninsula species septa 8/9 or 8/9 and 9/10 may eventually be found to be present. However, in approximately one third of the Peninsula species of *Pheretima* septum 8/9 is present while 9/10 is also present in nearly the same number of species. Among the Burmese forms, septum 8/9 is known to be present in only three species while 9/10 is known to be present (as well as 8/9) in only two species.

The inclusion of the seminal vesicles of xi within the posterior testis sac or sacs characterizes the following Peninsula species, in addition the eight Pahang forms:—*P. aringeana, baruana, dunckeri, evansi, papulosa, planata, polytheca, posthuma* (and also *bicincta* from Penang), or approximately one half of the known Peninsula species. Of the 65 Burmese and Andamanese species of *Pheretima* only 12 are known to have the anterior seminal vesicles included.

Pheretima brinchangensis Stephenson.

Pheretima brinchangensis Stephenson 1932, Bull. Raffles Mus. No. 7, p. 42. (Type locality, Brinchang Road, Cameron Highlands, Pahang. Types in the British Museum).

Gunong Siku, Telom Valley, Pahang. 3/35. 4,500 ft. Ten clitellate specimens, one partially clitellate specimen and one aclitellate specimen.

Mount Penelope (Summit), Telom Valley, Pahang. 3/35. 6,000 feet. Four clitellate specimens and nineteen aclitellate specimens.

Telom Valley, near Gunong Siku, Pahang. 3/35. 4,500 feet. Five clitellate or partially clitellate specimens and nine aclitellate specimens.

Gunong Brinchang, Pahang. 3/35. 4,500–5,500 feet. Two clitellate specimens.

Kuala Terla, Telom Valley, Pahang. 3/35. 4,000–4,500 feet. One aclitellate specimen and five clitellate specimens.

External characteristics.—Length, 60 to 85 mm. Diameter, 3 to 6 mm. The dorsum is characterized by a dark reddish pigmentation.

The setæ begin on ii on which segment there is a complete circle. There are no definite gaps in the setal circles, but dorsally the setæ are usually slightly more widely separated than ventrally. The setal formulæ are shown below. In most cases setal counts on xii and xx were not attempted because of maceration, damage or loss of setæ.

viii	*xvii*	*xviii*	*xix*	*viii*	*xii*	*xx*
4+48	22	14	19	52	62	53
3+46	20	15	17	49	52	48
4+61	22	15	21	65	71	51
5+54	18	12	19	59	—	—
5+57	19	14	19	62	—	—
3+48	17	12	17	51	—	—
4+46	20	14	17	50	—	—
2+55	21	13	17	57	—	—
3+59	21	17	21	62	—	—
7+57	20	16	19	64	—	—

The first set of figures in the column under "viii" indicates the number of setæ between the spermathecal lines dorsally, the second set of figures, the number of setæ between the lines ventrally, the sums of these two figures give the total number of setæ on segment viii.

The first dorsal pore is in 12/13 (15).

The clitellum is annular, extending from 13/14 to 16/17, intersegmental furrows and dorsal pores lacking. On one specimen there are several setal pits midventrally on xvi which appear to contain setæ.

The spermathecal pores are minute and superficial, dorsal, two pairs, in 7/8 and 8/9, each pore at the centre of a transversely oval, slightly tumescent whitish area. The pores of a side may be in line with each other, or the anterior pores may each be slightly lateral in position. The location of the spermathecal pores is indicated, even in quite small juveniles by definite whitish spots that stand out clearly from the pigmented background. Several specimens have one or more additional pores located as follows:—(1) An extra pore on the right side, in 7/8, lateral to the pore which is in line with the right pore of 8/9. (2) An extra pore on the right side in 7/8, lateral to the pore which is in line with the right pore of 8/9. (3) An extra pore on each side in 7/8, the two pores of a side closely paired. (4) An extra pore in 7/8 on the left side, the two pores of this side very closely paired. (5) On the right side in 7/8 the pore in line with the pore of 8/9 is much smaller than usual, a larger pore on this side about one intersetal interval lateral to the small pore. (6) An extra pore in 7/8 on the left side median to the pore that is in line with the pore of 8/9.

There is a single female pore which is median and in the transverse setal line on partially clitellate and aclitellate specimens.

The male pores are minute and invaginate into large copulatory chambers that open to the exterior by transversely slitshaped apertures in the setal circle of xviii. The copulatory chambers, in state of most complete eversion are represented by conspicuous, whitish columns about two mm. high and one mm. thick, circular in section and with flat ventral surfaces. On this surface there is a slight, crescentic groove towards the lateral margin with the concave side of the groove facing mesially. The male pore is within this groove.

There are no genital markings.

Internal anatomy—Septum 8/9 is complete but membranous, 9/10 lacking; 5/6 to 7/8 and 11/12 to 12/13 are very slightly thickened but membranous; 10/11 is very thin.

The intestine beings in xv (8). The intestinal cæca are simple and extend through three to four segments; the cæca with slight septal constrictions. The ventral margin may be smooth or provided with three to five small lobes posteriorly (one cæcum only or on both cæca of an individual).

The single heart of ix is on the right side in four specimens, on the left side in four specimens. The hearts of x are closely bound by connective tissue to the anterior face of 10/11. The hearts of xi are free dorsally but ventrally pass into the base of the testis sac. The last pair of hearts is in xiii (8). All hearts of ix to xiii pass into the ventral blood vessel.

There is a single, small testis sac in segment x. This sac is slightly wider transversely than anteroposteriorly and is pushed against the base of the testis sac of xi. The latter is u-shaped, the limbs of the u reaching dorsally only about half way up the sides of the gut. The limbs of the sac are stout and extend from 10/11 to 11/12 slightly dislocating 10/11 anteriorly. The seminal vesicles of xi are smallish, included within the testis sac of xi and at least partially surrounded by testicular coagulum. The seminal vesicles of xii are smallish and do not reach, in the upper portion of the segment, to the dorsal blood vessel. Pseudovesicles are lacking in all but one of the specimens that were dissected. In the exceptional individual there is a pair of fairly well developed, stalked pseudovesicles in each of segments xiii and xiv. The dorsal ampulla of each pseudovesicle contains a number of small, brownish bodies imbedded in a whitish material. The prostates extend through some or all of segments xv to xxi. Each prostate is in two main lobes, the prostatic duct dividing into two branches just before passing into the gland. In some specimens a third and smaller but separate lobe is intercalated between the two large lobes, one of the two main branches of the duct giving off a subsidiary branch to the small lobe. The duct is three to six mm. long, rather slender and is bent into a single, U-shaped loop or into an S-shape. The duct passes into the centre of the roof of the copulatory chamber. The latter is more or less conical and conspicuously protuberant into the coelom. No genital markings were observed within the chamber or special glands within the wall of the chamber but in all dissected specimens the chambers are somewhat softened. The male pore is at the ventral end of a tiny, shortly conical protrusion into the lumen of the chamber from the centre of the roof.

The spermathecal ampulla is rather ovoidal. The duct is slender and shorter than the ampulla and is abruptly narrowed only in the outermost portion of the parietes. The diverticulum is longer than the combined lengths of the duct and ampulla and comprises a long stalk without muscular sheen that is usually, in part, bent, looped or twisted and a shorter, ovoidal seminal chamber not sharply marked off from the stalk and only slightly thicker. The stalk is nearly as thick as the duct and passes into the duct close to the parietes. Each extra spermathecal pore opens into a normal spermatheca except as indicated below. (1) The diverticulum of the extra spermatheca is normal but the cœlomic portion of the duct and the ampulla are rudimentary. (3) The extra spermatheca is slightly smaller than the others and is without diverticulum. (4) The smaller spermathecal pore opens into a spermatheca with a shortly columnar diverticulum without differentiation into stalk and seminal chamber.

Diagnosis.—Quadrithecal, spermathecal pores dorsal, minute and superficial, two pairs, in 7/8 and 8/9. Male pores minute and invaginate into copulatory chambers. No genital markings. Setæ: viii/2-7+46-61, xvii/17-22, xviii/12-17, xix/17-21, 50-65/viii, 52-71/xii, 48-53/xx. First dorsal pore in 12/13. Length, 60-85 mm. Diameter, 3-6 mm.

Septum 8/9 complete but membranous, 9/10 lacking. Intestinal cæca simple. Testis sacs of x and xi unpaired, the sac of x small and ventral, of xi larger and u-shaped. Seminal vesicles of xi included within the posterior testis sac. Spermathecal duct shorter than the ampulla and slender; diverticulum comprising an elongate stalk and a much shorter, ovoidal seminal chamber.

Parasites.—In the cœlom of each of the dissected specimens a few spheroidal cysts were noted.

Remarks.—The types on which *brinchangensis* was erected were "soft and in very bad condition". A complete description was therefore not only impossible but in addition certain errors resulted. None of the present specimens have any clitellar glandularity external to the usual three segments, the clitellum ending abruptly with 13/14 and 16/17. The supposed clitellar glandularity on xiii of the type must therefore be regarded as an abnormality or else as not clitellar glandularity.

The first post-gizzard septum is attached to the parietes in the region of intersegmental furrow 8/9. Between its attachment and the attachment of the first pre-gizzard septum there is but one row of setal follicles visible (or follicular gaps in the muscular layer), while there are two rows of setæ visible between the parietal attachment of the first post-gizzard septum and the attachment of the septum next posteriorly. Furthermore the heart belonging to ix is posterior to the first post-gizzard septum while the heart would have to be anterior to this septum if the latter were in reality 9/10. The first post-gizzard septum is therefore 8/9 and not 9/10 as stated by Stephenson.

P. brinchangensis is, as has already been pointed out by Stephenson, similar to *P. dorsalis* Michælsen 1928 from Borneo. The latter species was erected on three specimens which are probably preserved in the Stockholm Museum. The description of *P. dorsalis* omits mention of a number of characteristics of importance. As a result *brinchangensis* can be distinguished at present from *dorsalis* only by the presence of septum 8/9. This difference is not of much importance in view of the fact that septum 8/9 when membranous has often been overlooked and assumed to be absent. In *P. dorsalis* the seminal vesicles of xi "anscheinend zugleich auch mit den Testikelnblasen des 11 Segments verschomolzen" (Ark. Zool. vol. 20A, No. 3, p. 52). Just what is meant by "verschmolzen" is not clear but in certain other species to which the same or a similar characterization has been applied the seminal vesicles are actually included within the posterior testis sac. It may be possible therefore that *brinchangensis* and *dorsalis* are identical.

Pheretima cameroni Stephenson.

Pheretima indica var. *cameroni* Stephenson 1932, Bull. Raffles Mus. No. 7, p. 47. (Type locality, Tanah Rata, Cameron Highlands, Pahang. The type, "in very bad condition", is in the British Museum).

Pheretima cameroni Gates 1935, Bull. Raffles Mus. No. 10, p. 82.

Gunong Brinchang, Pahang. 3/35. 4,500–5,500 feet. One clitellate specimen in three fragments.

Kuala Terla, Telom Valley, Pahang. 3/35. 4,000–4,500 feet. One aclitellate specimen.

External characteristics.—Length, of the clitellate specimen, 160 mm. Diameter, 6 mm. The aclitellate specimen is much smaller. The dorsum is reddish anteriorly, posterior to the clitellum light reddish, changing to brownish posteriorly.

Setæ are present, apparently, on ii, at least a few scattered pits are visible, the setæ either deeply retracted or lost as a result of maceration. The setæ are more widely separated dorsally than ventrally. Formulæ: vi/17, vii/20, viii/22, xvii/25, xviii/11, xix/26, 66/viii, 71/xii, 62/xx; vi/22, vii/22, viii/20, xvii/23, xviii/12, xix/23, 59/viii, 67/xii.

The first dorsal pore is in 12/13 (2). In the clitellate specimen there is however a small, apparently non-functional but pore-like marking in 11/12.

The clitellum is annular, extending from 13/14 to 16/17; setæ, intersegmental furrows and dorsal pores lacking.

The spermathecal pores are minute and superficial, four pairs, in 5/6 to 8/9.

There is a single, median female pore.

The male pores are minute, each pore at the centre of a circular, whitish, fairly large area that is surrounded by several concentric furrows. The portion of the body wall on which the male pore is located is very slightly elevated in a broadly conical fashion. This elevation may possibly represent an everted, slight parietal invagination.

There are no genital markings.

Internal anatomy.—Septa 5/6 to 7/8 are slightly strengthened and translucent as are also 10/11 to 12/13; 8/9 is represented by a ventral rudiment only; 9/10 lacking.

The intestine begins in xv. The intestinal cæca are simple and extend anteriorly into xxii or xxiii. The ventral margins are smooth but the cæca are slightly constricted by the septa through which they pass. There is a fairly large, lobed, collar on the œsophagus just behind the gizzard.

The single heart of ix is on the left side (1) or the right side (1). The hearts of x and xi are included within the testis sacs of their segments. The last pair of hearts is in xiii. All hearts of ix to xiii pass into the ventral blood vessel.

The testis sac of x is annular; the dorsal blood vessel included within the sac and surrounded by testicular coagulum. The testis sac of xi is cylindrical, the dorsal blood vessel included within the sac and surrounded by testicular coagulum. The seminal vesicles of xi are fairly large and are included within the testis sac of xi and imbedded in the testicular coagulum. The seminal vesicles of xii are fairly large, filling the segment and reaching dorsally into contact with the dorsal vessel. Pseudovesicles are lacking in xiii and xiv in the clitellate specimen but in the aclitellate specimen the pseudovesicles are represented in both segments by rudimentary structures in the shape of vertical cords or columns. The prostates extend through some or all of segments xv to xx. The prostatic duct is in xvii and xviii, almost straight, stout, slightly spindle-shaped, narrowed within the parietes, nearly six mm. long. The duct divides entally into five ductules just before passing into the prostate gland. The vas deferens is slightly thickened as it rises from the parietes.

The spermathecal ampulla is saccular, distended or collapsed. The duct is slender, slightly shorter than the ampulla, abruptly narrowed only in the outermost portion of the parietes. The diverticulum passes into the anterior face of the duct close to the parietes and comprises a stalk nearly as thick and almost as long as the duct, extending entally slightly onto the ampulla. The seminal chamber is spheroidal, marked off from the stalk by a definite constriction and with spermatozoal iridescence.

On the cœlomic face of the body wall of the clitellate specimen when pinned out there are readily visible, in the region of segments v to xiii, nine transverse rows of tiny, brownish bodies of variable shape and size, each brown body in or close to a gap in the musculature marking the position of a setal follicle.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, in 5/6-8/9. Male pores minute and (possibly) within slight parietal invaginations. No genital markings. Setæ: vi/17-22, vii/20-24, viii/20-22, xvii/23-25, xviii/11-14, xix/23-26, 59-66/viii, 67-76/xii, 62/xx. First dorsal pore in 12/13. Length, 145-160 mm. Diameter, 5-6 mm.

Intestinal cæca simple. Testis sacs of x and xi unpaired, the sac of x annular, the sac of xi cylindrical. Seminal vesicles of xi included within the posterior testis sac. Spermathecal duct slender and shorter than the ampulla; diverticulum with an elongate stalk constricted off from a spheroidal seminal chamber.

Remarks.—Slight traction on the prostatic duct of the clitellate specimen retracted slightly into the parietes the area bearing the male pore. This may perhaps be taken as indicating that the male pore is normally within a slight parietal invagination.

In the aclitellate specimen from Kuala Terla the male pore areas on xviii are much smaller than on the clitellate specimen, the spermathecal diverticula are rudimentary and the prostatic ducts are slender and confined to xviii.

Two small juveniles from Telom Valley, Gunong Siku, Pahang, probably also belong to *cameroni*.

Pheretima eluta n. sp.

Telom Valley, near Gunong Siku, Pahang. 3/35. F. 4500. Two aclitellate specimens (Numbers one and two).

Gunong Brinchang, Pahang. 3/35. 4,500–5,500 feet. One partially clitellate specimen (referred to as type or number three).

External characteristics.—Length, of the larger aclitellate specimen (number one), 65 mm.; of the type, 37 mm. Diameter, of the larger aclitellate specimen, 3 mm.; of the type, 2 mm.

The setæ begin on ii on which segment there is a complete circle. The setæ are small, closely and regularly spaced, perhaps a trifle more widely separated dorsally than ventrally. Spermathecal setæ on vi; 13, 12 and 12. On viii (type) there are thirty-six setæ.

The first dorsal pore is in 12/13 (3).

The clitellum is annular, extending from 13/14 to 16/17.

The spermathecal pores are minute and superficial, two pairs in 5/6 to 6/7.

The male pores are minute and superficial, each pore probably at the centre of a small, circular to transversely oval, whitish, epidermal tumescence.

On each of the specimens there is one pair of preclitellar genital markings, each marking about two intersetal intervals wide transversely and demarcated definitely by a circumferential furrow. There is a midventral space about two intersetal intervals wide between the two markings. On the largest specimen (number one) the markings are on viii, postsetal, extending only to 8/9. On the smaller specimens (numbers two and three) the markings extend slightly across 8/9 onto ix. There are two pairs of small, circular, postclitellar markings, two markings close to each male porophore (numbers one and two).

Internal anatomy.—Septa 5/6 to 7/8 are very slightly strengthened but transparent as are 10/11 to 12/13; 8/9 is membranous and complete (3); 9/10 lacking (3).

The intestine begins in xv (2). The intestinal cæca are simple and small, rather short, without lobulations of the margins (numbers one and two). In the larger specimen the cæca appear to originate in xxii or xxiii. The cæca of the type are quite unrecognizable.

The single heart of ix is on the right side (2). The hearts of x are included within the testis sac of that segment (3). The hearts of xi are included within the posterior testis sac (3). The last pair of hearts is in xiii (3). All hearts of ix to xiii pass into the ventral blood vessel (3).

The testis sac of x is annular but in the larger specimen (number one) is distended by the testicular coagulum only in the ventral portion so that the sac at first appears to be shortly u-shaped. In the second specimen and in the type the whole of the sac is distended by testicular coagulum. The testis sac of xi is cylindrical (3). the dorsal blood vessel included within the sac and surrounded by testicular coagulum. The seminal vesicles of xi are small, included in the posterior testis sac and at least partially surrounded by testicular coagulum. The seminal vesicles of xii are fairly large, nearly filling the segment and extending dorsally into contact with the dorsal blood vessel. The prostates extend through xvii to xix. The duct is slender and somewhat sigmoid in shape.

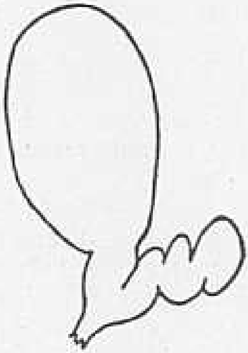


Fig. 1. *Pheretima eluta* n. sp. Spermatheca, × *ca.* 27.

The spermathecal duct is slender, shorter than or longer than the ampulla from which it is clearly marked off. The diverticulum passes into the duct close to the parietes and comprises a short stalk without muscular sheen and an elongately tubular seminal chamber which is looped, the loops very short, the limbs of the loops closely bound together by connective tissue, the ental end of the diverticulum just reaching up onto the ampulla. In the type the seminal chambers are transparent and without spermatozoal iridescence. The seminal chamber of each spermatheca of the larger specimen, in spite of the absence of the clitellum, is characterized by a marked, pinkish iridescence.

In the cœlom of viii, or viii and ix, on each side of the nerve cord is a patch of small glands, the stalks of the glands not quite confined to the parietes.

The body wall of the postclitellar segments is transparent except for two whitish, circular patches just median to the entrance of the prostatic duct into the parietes. These patches doubtless represent some sort of special gland but no distinct glandular bodies, as in viii, can be recognized.

Diagnosis.—Quadrithecal, spermathecal pores minute and superficial, two pairs, in 5/6-6/7. Male pores minute and superficial, each pore on a small, circular to oval epidermal tumescence. Genital markings paired, one postsetal pair on viii, one presetal and one postsetal pair on xviii. Setæ: vi/12-13, 36/viii. First dorsal pore in 12/13. Length, 37-65 mm. Diameter, 2-3 mm.

Septum 8/9 complete but membranous. Intestinal cæca simple. Testis sacs of x and xi unpaired, of x annular, of xi cylindrical. Seminal vesicles of xi included within the posterior testis sac. Spermathecal diverticulum with short stalk and elongately tubular seminal chamber, looped. Genital marking glands of viii stalked and cœlomic.

Remarks.—All of the specimens are macerated in the region behind segment xvi. Here the body wall is so transparent that the intersegmental furrows cannot be recognized nor the setæ counted. The septa in this region also cannot be accurately counted. Anteriorly the body wall is fairly well preserved but the internal organs are softened. The type is so badly macerated that the male porophores and the genital markings are unrecognizable.

Ten quadrithecal species of *Pheretima* with spermathecal pores in 5/6 and 6/7 are known: *P. morrisi* (Beddard) 1892 (peregrine); *P. urceolata* (Horst) 1893, *P. nana* (Rosa) 1896, *P. hasselti* (Horst) 1893, *P. lalangi* Michælsen 1923, and *P. silvestris* Michælsen 1923 (Sumatra); *P. choeina* Michælsen 1927 and *P. incongrua* Chen 1933 (China); *P. mertoni* Michælsen 1910 (Aru Isiands); and *P. sepikensis* Ude 1924 (New Guinea). From all of these *P. eluta* is distinguished by the following combination of characteristics: paired preclitellar genital markings, simple intestinal cæca, unpaired annular or cylindrical testis sacs.

Pheretima miniata n. sp.

Gunong Brinchang, Pahang. 3/35. 4500–5500 feet. One clitellate specimen.

External characteristics.—Length, 55 mm. Diameter, 4½ mm. Dark, bluish red pigmentation both dorsally and ventrally but towards the posterior end lighter on the ventrum.

The setæ begin on ii on which segment there is, apparently, a complete circle. The setæ are small, very closely and regularly spaced on the ventrum; on the dorsum more widely and irregularly spaced and perhaps slightly larger. Formula: vi/34, xvii/18, xviii/14, xix/21.

The first dorsal pore is in 12/13.

The clitellum is annular, extending from 13/14 to 16/17.

There is a single female pore.

The male pores are minute and superficial. Each pore is located on the median portion of a definitely demarcated, oval, whitish, fairly large area which is provided with a slightly tumescent rim. The area is diagonal in position and so placed that the median end of the oval is directed anteromesially and the lateral end posterolaterally. The two porophores are separated by a midventral space slightly wider than the width of the porophores. On each porophore is a crescentic, seminal groove directed postero-laterally from the male pore and with the concave side of the furrow facing anterolaterally.

There are no further genital markings.

Internal anatomy.—Septa 5/6 to 7/8 are very slightly strengthened but transparent as are 10/11 to 12/13; 8/9 and 9/10 are complete but membranous, 9/10 pushed back, except ventrally, into contact with 10/11 but clearly separated from the latter in the lower portion of the body by the testis sac.

The intestine begins in xv. The intestinal cæca are simple, short, probably extending only through one or two segments.

The heart of ix is on the right side. There appears to be a heart on the left side of ix but in the ventral portion of the body this vessel suddenly becomes very thin and cannot be traced into the ventral vessel. The hearts of x and xi pass into the testis sacs only in the ventral portion of the body. The last pair of hearts is in xiii. All hearts of ix to xiii pass into the ventral vessel.

The testis sacs of x and xi are unpaired and u-shaped. In x the limbs of the u are flattened out ventrally thus pushing 9/10 to some distance from 10/11. In xi the dorsally directed limbs of the u reach only half way up the sides of the œsophagus. The seminal vesicles of xi are small and included within the posterior testis sac. The seminal vesicles of xii are larger and are in contact transversely above the dorsal blood vessel. The prostatic duct is slightly curved, just over two mm. in length and passes into a patch of whitish tissue in the parietes that does not project into the cœlom.

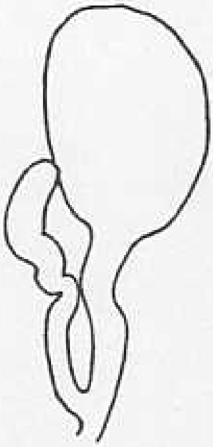


Fig. 2. *Pheretima miniata* n. sp. Spermatheca, × *ca.* 20., after removal of coagulum (?) from the duct.

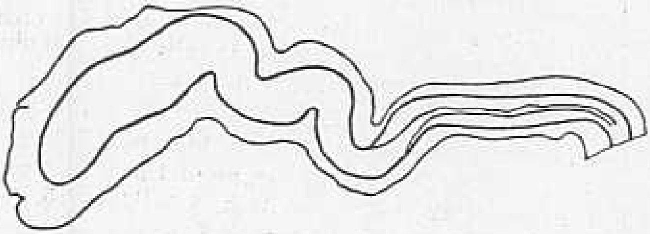


Fig. 3. *Pheretima miniata* n. sp. Spermathecal diverticulum, × *ca.* 45., showing the outer layer of coagulum (?).

The spermathecal duct is as long as or longer than the ampulla and at first appears to be fairly stoutish but with a slightly wavy margin. A fairly thick layer of coagulum (?) can be easily scraped off displaying a slender duct with a pinkish, muscular appearance. The diverticulum is as long as the duct and ampulla together or shorter, passes into the duct at the parietes, and comprises a short stalk without muscular sheen and a wider seminal chamber that is either looped very shortly and closely or slightly constricted. The seminal chamber is marked by a spermatozoal iridescence and is surrounded, like the duct by a layer of coagulum. This coagulum is continued on the diverticular stalk to the duct but is thinner here than on the seminal chamber.

Diagnosis.—Quadrithecal, spermathecal pores minute and superficial, two pairs, in 5/6-6/7. Male pores minute and superficial, each pore on a diagonally placed oval porophore, a crescentic seminal groove directed posterolaterally from the male pore. No genital markings. Setæ: vi/34, xvii/18, xviii/14, xix/21. First dorsal pore in 12/13. Length, 55 mm. Diameter, 4½ mm.

Septa 8/9 and 9/10 present but membranous. Intestinal cæca simple. Testis sacs of x and xi unpaired and u-shaped. Seminal vesicles of xi included within the posterior testis sac. Spermathecal duct as long as or longer than the ampulla; diverticulum with a short stalk and an elongately tubular seminal chamber, looped or constricted.

Remarks.—The worm is completely ruptured in the region of segment xv, the two portions held together, prior to dissection, only by the cuticle.

P. miniata is distinguished from all other quadrithecal species of *Pheretima* with spermathecal pores in 5/6 and 6/7 by the presence of seminal grooves on the male porophores.

Pheretima ralla n. sp.

Gunong Brinchang, Pahang. 3/35. 4,500–5,500 feet.

Three clitellate specimens: number one partially clitellate, number two partially clitellate but with clitellar glandularity more fully developed, number three aclitellate.

External characteristics.—Length, 25 to 39 mm. Diameter, 1½ mm. Pigmentation, reddish on the dorsum.

The setæ begin on ii on which segment there is a complete circle. Formulæ: vi/12, xvii/9, xviii/6, xix/9; vi/13, xvii/10, xviii/6, xix/9; vi/12, xvii/11, xviii/8, xix/10.

The first dorsal pore is in 12/13 (2) but in one specimen there is a definitely pore-like marking in 11/12.

The clitellum is annular, and on the most mature specimen extends from 13/14 to 16/17. On this worm setæ are still visible ventrally on all three segments.

The spermathecal pores are minute and superficial, two pairs, on vi and vii. The pores are located on the anterior portion of their segments but are quite definitely behind the intersegmental furrow.

The male pores are minute and superficial, each pore on a transversely oval, slightly raised, whitish area (3).

There are no genital markings (3).

Internal anatomy.—Septa 5/6 to 7/8 are transparent as are 10/11 to 12/13; septa 8/9 and 9/10 are lacking.

The intestinal cæca are probably simple.

The last pair of hearts is in xiii (1). The hearts of x and xi are included within the testis sacs (2).

There is a pair of vertical testis sacs belonging to segment x, each sac reaching from the ventral parietes to the dorsal blood vessel (2). The unpaired testis sac of xi is horseshoe-shaped (2). The seminal vesicles of xi are small and are included within the posterior testis sac (2). The vesicles of xii are larger and are in contact with the dorsal blood vessel (2). The prostatic duct is slender, without muscular sheen, bent into a U or an S-shape. Ectally the duct is slightly thickened in number two.

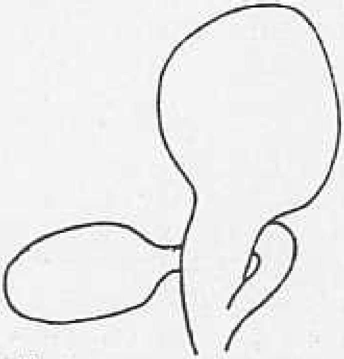


Fig. 4. *Pheretima ralla* n. sp. Spermatheca, × *ca.* 63.

The spermathecal duct is shorter than the ampulla. The diverticulum is as long as or longer than the duct and ampulla together, passes into the duct at the parietes and comprises a stalk without muscular sheen which is longer than the duct and about half as thick, and an ovoidal to spheroidal seminal chamber.

Diagnosis.—Quadrithecal, spermathecal pores minute and superficial, two pairs, on the anterior margins of vi and vii. Male pores minute and superficial, each pore on an indistinctly delimited, epidermal tumescence. Setæ: vi/12–13, xvii/9–11, xviii/6–8, xix/9–10. First dorsal pore in 12/13. Length, 25–39 mm. Diameter, 1½ mm.

Paired vertical testis sacs in x. An unpaired, horseshoe-shaped testis sac in xi. Seminal vesicles of xi included within the posterior testis sac. Spermathecal diverticulum longer than duct and ampulla, stalk longer than duct, ovoidal to spheroidal seminal chamber.

Remarks.—The female pores were not definitely identified on two specimens but on the other there is, apparently, a pair of pores. The partially clitellate specimens were dissected. Both specimens had fragmented across the clitellar region during examination of the external characteristics. As a result of maceration in the postclitellar segments the intestinal cæca cannot be definitely identified. The hearts of xiii were not found in one specimen, probably as a result of the fragmentation or maceration.

P. ralla is distinguished from *P. canaliculata* Gates 1932 (Burma) by the absence of genital markings and seminal grooves, the simple intestinal cæca, and characteristics of the testis sacs.

Pheretima rallida n. sp.

Gunong Brinchang, Pahang. 3/35. 4500–5500 feet.

One clitellate specimen.

External characteristics.—Length, 66 mm. Diameter, 3 mm. Pigmentation, reddish on the dorsum.

The setæ begin on ii on which segment there is a complete circle. Formula: vi/13, xvii/13, xviii/10, xix/14, 50/viii.

The clitellum is annular, extending from 13/14 to 16/17, intersegmental furrows, dorsal pores and setæ lacking.

The first dorsal pore is in 4/5.

The spermathecal pores are minute and superficial, two pairs, on the anteriormost margins of vi and vii.

There is a single female pore.

The male pores are minute and superficial, each pore at the centre of a transversely oval, whitish, slightly raised porophore, demarcated peripherally by an incompletely circumferential furrow. The porophores are two to three intersetal intervals wide transversely.

There are no genital markings.

Internal anatomy.—Septa 5/6 to 7/8 are membranous as are 10/11 to 12/13; 8/9 and 9/10 are complete but membranous.

The intestinal cæca are simple and short, constricted slightly by the septa through which they pass.

The last pair of hearts is in xiii. The hearts of x and xi pass into the testis sacs only ventral to the gut. The hearts of x and xi are as large as those of xii and xiii.

The testis sacs of x and xi are unpaired and u-shaped, the dorsally directed limbs of the u reaching only half way up the sides of the gut. The seminal vesicles of xi are small and included within the posterior testis sac. The seminal vesicles of xii are larger and are in contact with the dorsal blood vessel. The prostate extends through xvi to xx. The prostatic duct is slender and two to three mm. long.

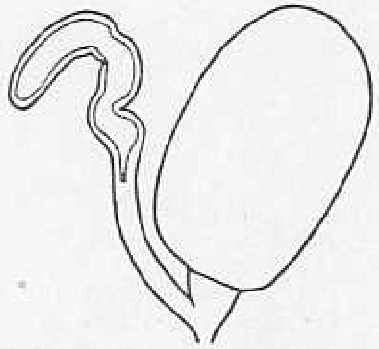


Fig. 5. *Pheretima rallida* n. sp. Spermatheca, × *ca.* 20.

The spermathecal duct is shorter than the ampulla from which it is sharply marked off and is abruptly narrowed within the parietes. The diverticulum passes into the duct at the parietes and comprises a stalk and a tubular seminal chamber with spermatozoal iridescence; the chamber may be shortly looped into an approximation to zigzag. As is, the diverticulum may be longer than or shorter than the combined lengths of duct and ampulla.

Diagnosis.—Quadrithecal, spermathecal pores minute and superficial, two pairs, on the anterior margins of vi and vii. Male pores minute and superficial, each pore on a small, transversely oval porophore. No genital markings. Setæ: vi/13, xvii/13, xviii/10, xix/14, 50/viii. First dorsal pore in 4/5. Length, 66 mm. Diameter, 3 mm.

Septa 8/9–9/10 present but membranous. Intestinal cæca simple. Testis sacs of x and xi unpaired and u-shaped. Seminal vesicles of xi included within the posterior testis sac. Spermathecal duct shorter than the ampulla; diverticulum with stalk and elongately tubular seminal chamber.

Remarks.—The type is softened and is ruptured in the clitellar region.

P. rallida is close to *P. ralla* n. sp., from which it is distinguished by the anterior location of the first dorsal pore, the unpaired female pore, the presence of septa 8/9 and 9/10, the exclusion of the hearts of x and xi from the testis sacs dorsally, the u-shaped testis sacs, the relatively shorter spermathecal duct, and the elongately tubular seminal chamber. Although there are these differences between the two forms, some of the differences may eventually prove to be of little if any taxonomic significance. None of the types of *P. ralla* are fully clitellate and some of the organs may not be fully developed. There is no spermatozoal iridescence in the seminal chambers of the spermathecæ which did not clear either in lactophenol or glycerine. Further information is needed as to the variability of certain of the characteristics which have been used to distinguished the two species.

Pheretima rubella n. sp.

Kuala Terla, Telom Valley, Pahang. 3/35. 4,000–4,500 feet. Ten clitellate or partially clitellate specimens (types).

Telom Valley, near Gunong Siku, Pahang. 3/35. F. 4,500. One clitellate specimen.

Mount Penelope (summit), Ulu Telom, Pahang. 3/35. 6,000 feet. One clitellate specimen.

External characteristics.—Length, 30 to 60 mm. Diameter two or three mm. Pigmentation, dark reddish on the dorsum.

The setæ begin on ii on which segment there is a complete circle. The setæ are very small, closely crowded on the ventral surface, much more widely separated dorsally and perhaps a trifle larger. There is a definite mid-dorsal gap in the circles of the postclitellar segmets and sometimes also on some of the preclitellar segments but there is no midventral gap. The formulæ are indicated below. On one specimen 58 setæ were counted on xii, 54 on xx.

vi	*vii*	*xvii*	*xviii*	*xix*	*Locality*
10	11	11	0	13	Kuala Terla
11	12	15	0	13	”
10	11	14	2	13	”
11	12	14	0	13	”
10	10	12	0	12	”
11	12	12	0	13	”
14	13	16	8	19	Telom Valley
14	13	—	6	—	Mt. Penelope

The first dorsal pore is in 10/11 (3) or 11/12 (5).

The clitellum is annular, extending from 13/14 to 16/17 and when fully developed is, apparently, without dorsal pores, intersegmental furrows or setæ.

There is a single female pore.

The spermathecal pores are minute and superficial, three pairs, on the posterior margins of v, vi and vii. On some of the specimens each pore is surrounded by a tiny, tumescent, circumferential lip.

The male pores are minute and superficial, each pore at or near the centre of the central portion of a porophore. The porophores are never very definite but on those specimens on which these markings are clearest the appearance is as follows; a transversely oval or circular, flat, central area bearing the male pore is marked off by a very slight furrow from a slightly more tumescent portion without definite peripheral demarcation but which extends to 17/18 and 18/19 or even onto xvii and xix interrupting the intersegmental furrows. The two whitish areas may be separated midventrally by an unmodified area bearing setæ or the setigerous midventral area may also be whitened or the two porophores may be in contact or fused midventrally and when so fused male setæ are lacking.

There are no further genital markings.

Internal anatomy.—Septa 5/6 to 7/8 are very slightly strengthened but are transparent as are also 10/11 to 12/13; 8/9 and 9/10 are complete but very thin and transparent.

The intestine begins in xvi (4). The intestinal cæca are simple, short, in two or three segments, the margins constricted slightly by the septa through which the cæca pass.

The single heart of ix is on the left side (3) or the right side (1). In another specimen there appears to be a pair of well developed hearts in ix but the vessel on the right side narrows abruptly in the ventral portion of the segment into a mere transparent filament which cannot be traced to the ventral trunk. The last pair of hearts is in xiii (4). All hearts of ix to xiii pass into the ventral blood vessel (4).

The testis sacs of x and xi are paired and ventral. The sacs of x are larger and are rather flattened dorsoventrally, dislocating 9/10 anteriorly. The sacs of xi are ovoidal, extending from 10/11 to 11/12. Between the sacs of a segment there is visible a single, perfectly transparent, very delicate horizontal membrane in which is the ventral blood vessel. The seminal vesicles of xi are fairly large and reach to or nearly to the dorsal blood vessel. Ventrally each vesicle is attached to the roof of a testis sac as well as to the posterior face of 10/11. It is however possible, in best preservation, to dissect off the vesicle without opening the testis sac. The seminal vesicles of xii are slightly larger and are in contact transversely above the dorsal blood vessel. In one specimen 11/12 and 12/13 are in contact on the left side and 11/12 is ruptured so that the left vesicle of xii is almost entirely in xiii. The prostates extend through xvii to xxi. The prostatic duct has a muscular sheen, is bent into a U or an S-shape and is two to four mm. long.

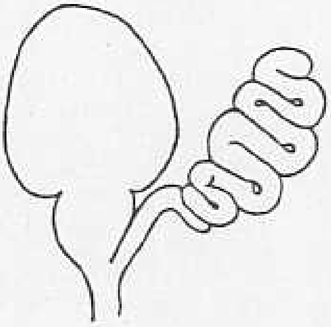


Fig. 6. *Pheretima rubella* n. sp. Spermatheca, × *ca.* 27.

The spermathecal ampullæ are fairly large and are distended by whitish material. The duct is slightly muscular, shorter than the ampulla from which it is fairly sharply marked off, abruptly narrowed within the parietes. The diverticulum passes into the anterior face of the duct at the parietes and comprises a slender stalk which is at least longer than the duct and may be longer than the combined lengths of duct and ampulla and a still longer, slightly wider but thin walled seminal chamber. The latter is characterized by a spermatozoal iridescence and is looped, usually in a fairly regular approximation to zigzag, with many or most of the loops in the same plane, the limbs of the loops in contact.

No glandular material is noticeable in the body wall dorsal to the male porophores.

Diagnosis.—Sexthecal, spermathecal pores minute and superficial, three pairs, on the posterior margins of v, vi and vii. Male pores minute and superficial, each pore on a fairly large, epidermal tumescence. No genital markings. Setæ: vi/10–14, vii/10–13, xvii/11–16, xviii/0–8, xix/12–19, 58/xii, 54/xx. First dorsal pore in 10/11–11/12. Length, 30–60 mm. Diameter, 2–3 mm.

Septa 8/9 and 9/10 present but membranous. Intestinal cæca simple. Testis sacs of x and xi paired and ventral. Spermathecal duct shorter than the ampulla, diverticular stalk longer than the duct but shorter than the elongately tubular seminal chamber which is looped in a fairly regular zigzag.

Remarks.—The spermathecal pores are, in some specimens, quite obviously segmental, a definite strip of tissue separating the lip of the pore from the intersegmental furrow next behind. In other worms the pores at first appear to be intersegmental. After removal of the cuticle from such specimens the pores can usually be recognized as segmental. In two specimens, after removal of the cuticle the pores still appeared to be intersegmental. On these worms however, the intersegmental furrows are not visible in the immediate vicinity of the pores though the pores do appear to be in line with the furrows where next visible.

The male pores are difficult to recognize even with high magnification and brilliant illumination and can usually be definitely identified only when slight traction on the epidermis in the vicinity has actually opened the pore.

In one specimen the testis sacs of x are unusually large and are bent upwards on the posterior face of 9/10 so that each sac has a rather L-shaped appearance.

Pheretima rutila n. sp.

Telom Valley, near Gunong Siku, Pahang. 3/35. F. 4,500. One clitellate specimen.

External characteristics.—Length, 40 mm. Diameter, 2½ mm.

The setæ begin on ii on which segment there is a complete circle. Formula: vi/15, vii/13, xvii/13, xviii/8, xix/13.

The clitellum is annular, extending from just behind the setæ of xiii to just in front of the setæ of xvii, setæ and intersegmental furrows lacking, incompletely occluded dorsal pores at the site of 13/14 and 16/17.

There is a single female pore.

The spermathecal pores are minute and superficial, three pairs, in 5/6 to 7/8.

The male pores are minute and superficial, each pore on an indistinctly delimited, very slightly tumescent, nearly circular, whitish area.

There are no genital markings.

Internal anatomy.—Septa 5/6 to 7/8 and 10/11 to 12/13 are very slightly strengthened but are all transparent; 8/9 and 9/10 are complete but very thin and transparent.

The intestine begins in xvi. The intestinal cæca are simple, short, extending through two or three segments, slightly constricted by the septa through which the cæca pass.

The last pair of hearts is in xiii. No hearts belonging to ix were found. The hearts of x and xi pass ventrally into the posterior faces of the limbs of the testis sacs.

The testis sacs of x and xi are unpaired and u-shaped. In x the limbs of the sac reach dorsally nearly to the dorsal blood vessel, but in xi the limbs of the sac reach dorsally only about three fourths of the distance up the gut. The dorsally directed limbs of the sacs are not bound to the gut. The seminal vesicles of xi are free and are crowded ventrally between the limbs of the testis sac and the anterior septum. The vesicles of xii are larger and are in contact transversely above the dorsal blood vessel. The prostates extend through xvii to xxi. The prostatic duct is about two mm. long, bent into a U-shaped loop, the ectal limb of the loop much thicker and with muscular sheen, the ental limb slender and without sheen.

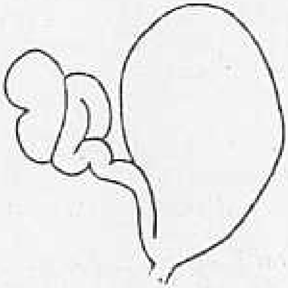


Fig. 7. *Pheretima rutila* n. sp. Spermatheca, × *ca.* 27.

The spermathecal duct is much shorter than the ampulla and is represented only by the portion within the parietes and a very short cœlomic portion just at the parietes into which the diverticular stalk passes. The diverticulum comprises a stalk which is longer than the duct and a longer, slightly wider, thin-walled, tubular seminal chamber that is variously looped. As is, the diverticulum may be longer or shorter than the combined lengths of duct and ampulla but straightened out the diverticulum is of course much longer than the combined lengths of duct and ampulla. There is no spermatozoal iridescence in any of the spermathecal diverticula.

Diagnosis.—Sexthecal, spermathecal pores minute and superficial, three pairs, in 5/6–7/8. Male pores minute and superficial, each pore on an indistinctly delimited, epidermal tumescence. Setæ: vi/15, vii/13, xvii/13, xviii/8, xix/13. Clitellum from just behind the setæ of xiii to just in front of the setæ of xvii. Length, 40 mm. Diameter, 2½ mm.

Septa 8/9 and 9/10 present but membranous. Intestinal cæca simple. Testis sacs of x and xi unpaired and u-shaped. Seminal vesicles of xi excluded from the posterior testis sac. Spermathecal duct very short, diverticulum with stalk longer than the duct and a longer, tubular seminal chamber, looped.

Remarks.—The type is rather soft and broke into two, in the postprostatic region, while the external characteristics were being studied.

P. rutila is close to *P. rubella* from which it can be distinguished at present only by the greater extent of the clitellum, the intersegmental location of the spermathecal pores, the absence of hearts of ix, the unpaired u-shaped testis sacs, and the short spermathecal duct. Some at least of these characteristics may represent individual variations or abnormalities (as for instance the absence of hearts of ix).

Pheretima serena n. sp.

Gunong Brinchang, Pahang. 3/35. 4,500–5,500 feet. One clitellate specimen.

External characteristics.—Length, 39 mm. Diameter, 2 mm.

The clitellum is annular, extending from 13/14 to 16/17; intersegmental furrows, dorsal pores and setæ lacking.

Setal formula: vi/23, xvii/12, xviii/7, xix/12.

The first dorsal pore is in 3/4.

The spermathecal pores are minute and superficial, transverse slits, two pairs, on the posteriormost margins of v and vi. Each pore is surrounded by an annular tumescence.

There appears to be a pair of female pores.

The male pores are minute and superficial, each pore on an indistinctly delimited, slightly tumescent, fairly large, whitish porophore.

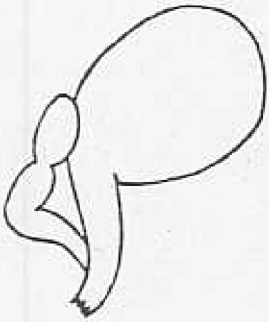
There are no genital markings.

Internal anatomy.—Septa 5/6 to 7/8 are very thin and transparent as are 10/11 to 12/13; 8/9 and 9/10 are complete but very thin.

The intestine begins in xv.

The single heart of ix is on the left side. The hearts of x and xi pass into the testis sacs ventral to the gut. The last pair of hearts is in xiii.

The testis sacs of x and xi are unpaired and u-shaped, the dorsally directed limbs of the u only reaching half way up the sides of the gut. The seminal vesicles of xi are small and included within the posterior testis sac. The vesicles of xii are larger and are in contact with the dorsal blood vessel. The prostates extend through xvii to xix. The prostatic duct is short, slender, without muscular sheen, about 2 mm.long.



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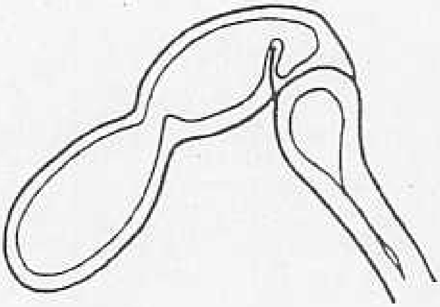

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Fig. 8. *Pheretima serena* n. sp. Spermatheca, × *ca.* 27.
Fig. 9. *Pheretima serena* n. sp. Spermathecal diverticulum, × *ca.* 60.

The spermathecal duct is slender and shorter than the ampulla from which it is fairly well marked off. The diverticulum passes into the duct close to the parietes, is shorter than the combined lengths of duct and ampulla, and comprises a stalk which is distinguished from the longer seminal chamber by the lack of spermatozoal iridescence and the smaller lumen. The seminal chamber is constricted into several ovoidal segments, the chamber with an appearance suggestive of a string of sausages.

Diagnosis.—Quadrithecal, spermathecal pores minute and superficial, two pairs, on the posterior margins of v and vi. Male pores minute and superficial, each pore on a fairly large, indistinctly delimited porophore. No genital markings. Setæ: vi/23, xvii/12, xviii/7, xix/12. First dorsal pore in 3/4. Length, 39 mm. Diameter, 2 mm.

Septa 8/9 and 9/10 present but membranous. Testis sacs of x and xi unpaired and u-shaped. Seminal vesicles of xi included within the posterior testis sac. Spermathecal diverticulum with short stalk and elongately tubular seminal chamber constricted into several sausage-shaped segments.

Remarks.—The type is somewhat macerated, especially in the region of the intestinal cæca which are entirely unrecognizable. The description above is based on an assumption that the male pores are on segment xviii. There is however on segment i (counting forward from the male pore segment as xviii) a circle of what look like setal pits though no setæ were definitely identified.

P. serena is very close to *P. rallida* n. sp. from which it is distinguished at present only by the location of the spermathecal pores on v and vi rather than vi and vii, the slightly larger number of spermathecal setæ on vi, and the relatively longer spermathecal duct. The position of the first dorsal pore (in 3/4) cannot be used, at present, in view of known variation in location of this aperture, as a criterion of specific distinctness from a form with the pore in 4/5.

The type of *P. serena* is also similar to the types of *P. rubella* n. sp. and might be considered as an abnormal specimen of the latter, lacking a posterior pair of spermathecæ, were it not for the differences in the testis sacs and the location of the first dorsal pore.

Pheretima sigillata n. sp.

Telom Valley, near Gunong Siku, Pahang. 3/35. F. 4500. Two clitellate specimens, one of which is designated the type.

Gunong Brinchang, Pahang. 3/35. 4,500–5,500 feet. Two aclitellate specimens.

External characteristics.—Length, of the larger clitellate specimen, 31 mm. Diameter, nearly 3 mm. The aclitellate specimens are much smaller. The dorsum is characterized by a red pigmentation, anterior to the clitellum with a dark blueish tinge, posterior to the clitellum with a brownish tinge, fading to light brownish at the tail end.

The setæ begin on ii on which segment there is a complete circle. The setæ are small, closely and regularly spaced, slightly more widely separated dorsally than ventrally. Formulæ:—vi/23, vii/22, viii/25, xvii/20, xviii/20, xix/24, 62/viii, 62/xii, 55/xx (larger clitellate specimen); xvii/22, xviii/18, xix/21; vi/20, vii/24, viii/25, xvii/20, xviii/18, xix/20.

The first dorsal pore is in 11/12 (3).

The clitellum is annular, extending from 13/14 to 16/17; intersegmental furrows, dorsal pores and setæ lacking.

The spermathecal pores are minute and superficial, four pairs, in 5/6 to 8/9. There is a pair of female pores on xiv.

The male pores are minute and superficial, each pore at the centre of a small, circular, slightly raised, whitish area that extends posterior to the setæ of xviii slightly further than anterior to the setæ. The male pores appear to be very slightly posterior to the transverse setal line.

The genital markings are paired and presetal, one pair each on segments x, xi, xvii, xviii and xix. One of the aclitellate specimens lacks the markings on xix. Each marking has a slightly depressed, greyish translucent, circular, central area about one intersetal interval in width, surrounded by a slightly raised, whitish area which is not definitely delimited peripherally. The greyish areas are separated by a midventral space equal to three to five intersetal intervals.

Internal anatomy.—Septa 5/6 to 7/8 as well as 10/11 to 12/13 are very slightly strengthened but membranous; 8/9 and 9/10 are complete but very delicate and transparent.

The intestinal cæca are simple, extending through three or four segments. The intestine begins in xv.

The single heart of ix is on the right side (1) or the left side (2). The hearts of x and xi pass ventrally into the testis sacs of their segments. The last pair of hearts is in xiii (3). All hearts of ix to xiii pass into the ventral blood vessel.

The testis sacs of x and xi are unpaired. The sac of x in the larger clitellate specimen is u-shaped (?) but the limbs of the u reach only half way up the sides of the gut. In the aclitellate specimen the sac of x appears to be annular but with the testicular coagulum only in the ventral portion which has a u-shaped appearance. The sac of xi appears also be u-shaped with the limbs of the u extending only half way up the sides of the gut. The seminal vesicles of xi are included within the posterior testis sac and at least partially surrounded by testicular coagulum. The vesicles of xii fill the cœlom of the segment to the dorsal blood vessel. No pseudovesicles were found in xiii or xiv of any of the specimens. The prostates extend through xvii to xix. The prostatic duct is slender, about two mm. long, without muscular sheen, J- or S-shaped and confined to xviii.

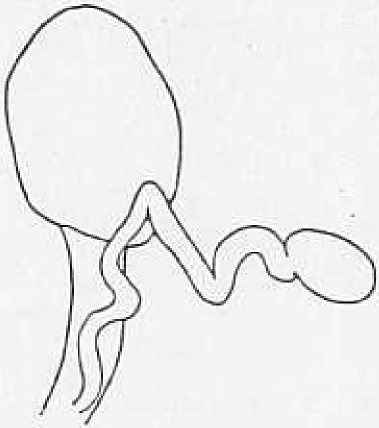

Fig. 10. *Pheretima sigillata* n. sp. Spermatheca, × *ca.* 45.

The spermathecal duct is without muscular sheen and is about as long as the ampulla. The diverticulum passes into the duct slightly ental to the parietes and is longer than the combined lengths of duct and ampulla. The stalk which is also longer than the combined lengths of duct and ampulla is without muscular sheen and is variously twisted or bent or shortly looped into an approximation to a regular zigzag. The seminal chamber is shortly ovoidal to spheroidal, distended and transparent, without spermatozoal iridescence.

A stalked gland projectes from each genital marking into the cœlom.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, in 5/6–8/9. Male pores minute and superficial, each pore slightly posterior to the transverse setal line of xviii and on a small circular porophore. Genital markings paired and presetal on x, xi, xvii, xviii and xix. Setæ: vi/20–23, vii/22–24, viii/25, xvii/20–22, xviii/18–20, xix/20–24, 62/viii, 62/xii, 55/xx. First dorsal pore in 11/12. Length, 31 mm. Diameter, 3 mm.

Septa 8/9 and 9/10 present but membranous. Intestinal cæca simple. Testis sacs of x and xi unpaired, of x u-shaped to annular, of xi u-shaped. Seminal vesicles of xi included within the posterior testis sac. Spermathecal duct as long as the ampulla, diverticulum with an ovoidal to spheroidal seminal chamber and a stalk longer than combined lengths of duct and ampulla. Genital marking glands stalked and coelomic.

Remarks.—Externally these specimens appeared to be in a very good state of preservation, but each of three specimens fragmented in the anterior region during study of the external characteristics in spite of the utmost care. The fourth specimen (aclitellate) on which the anlage of the genital markings are just barely recognizable was left unstudied.

Because of the maceration and fragmentation and the small size of the organs the observations on the testis sacs are rather unsatisfactory. It is possible that the sacs, particularly in x, are in reality annular with only the ventral portion distended by testicular coagulum.

P. sigillata is similar in many respects to *P. exigua* Gates 1930 from Burma. The differences between the two species though small are numerous.